

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of Mirchandani	:	
	:	
Group Art Unit: 1742	:	HYBRID CEMENTED
	:	CARBIDE COMPOSITES
Examiner G. Wyszomierski	:	
	:	
Application Serial No. 10/735,379	:	Confirmation No. 1694
	:	
Filed December 12, 2003	:	

DECLARATION OF PRAKASH K. MIRCHANDANI, Ph.D.

Pittsburgh, Pennsylvania 15222-2312  
August 27, 2007

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

I, Prakash K. Mirchandani, declare as follows:

1. I am a citizen of the United States and currently reside at 11323 Pampass Pass, Houston, Texas 77095.

2. I am listed as the sole inventor on the above-identified patent application ("the Present Application"). I am over the age of eighteen and am competent to make the statements in this Declaration.

3. I received a B.S. degree in Mechanical Engineering from the Indian Institute of Technology in 1970. I was awarded a Ph.D. in Metallurgical Engineering from the Michigan Technological University in 1986.

4. I have worked in the field of metallurgy, developing improved cemented carbides and other metallurgic materials and articles, for over 20 years. Since 1999, I have been employed in metallurgy at ATI Metalworking Products, a division of Allegheny Technologies Incorporated ("ATI"). From 1999, I held the position of R&D

Director, and since 2001 have held the position of Technical Director - Carbide Products at ATI Firth Sterling, a business unit of ATI Metalworking Products. As Technical Director - Carbide Products at ATI Firth Sterling, I have been responsible for directing and performing development work on composite and other types of rotary tools, including the composite rotary tools described in the Application.

5. I have reviewed and am thoroughly familiar with the subject matter described in the Present Application. I also have thoroughly reviewed U.S. Patent No. 4,956,012 to Jacobs et al. (the "Jacobs patent").

6. One aspect of the invention described in the Application is directed to an improved hybrid cemented carbide composite material including a dispersed (discontinuous) phase of cemented carbide within a continuous phase of cemented carbide. The contiguity ratio of the dispersed phase is less than or equal to 0.48, which imparts certain improved physical properties to the composite material.

7. Example 1 of the Present Application measures the contiguity ratios and physical properties of an embodiment of the invention, shown in Figure 4B of the Present Application, and prior art embodiments, shown in Figures 2 and 4A of the Application. Figure 4B depicts a cemented carbide having a contiguity ratio of 0.31 and a hardness of 15.2 MPa·m<sup>1/2</sup>. The hardness of the material shown in Figure 4B is 18% greater than the hardness of the prior art embodiments shown in Figures 2 and 4A, which are materials having contiguity ratios of 0.52 and 0.5, respectively.

8. The general concept of contiguity ratio in metallography was developed in part by E.E. Underwood. See Underwood, Quantitative Stereology, pp. 279-290 (Addison Wesley 1970), attached under Tab 1. The concept of a contiguity ratio was further adapted to describe cemented carbide materials by Joseph Gurland. See Gurland, "Application of Quantitative Microscopy to Cemented Carbides", Practical Applications of Quantitative Metallography, ASTM Special Technical Publication 839, pp. 65, 70-76 (ASTM 1984), attached under Tab 2. Gurland's technique was used to calculate the contiguity ratios cited in the Application. Generally, contiguity ratio is a property of any material including two phases. Thus, Gurland applied the concept of contiguity ratio to cemented carbides, which have a first, discontinuous phase of carbide

particles, and a second, continuous phase of binder. In the Application, I applied the concept of a contiguity ratio to hybrid cemented carbides, which also have two phases, a dispersed, discontinuous phase of cemented carbide particles, and a continuous phase of cemented carbide serving as the binder. Given that contiguity ratio as applied to cemented carbides describes a physical relationship between the dispersed particles of the discontinuous phase, it may be readily applied to hybrid cemented carbide materials.

9. I understand that the patent examiner examining the Application has inquired about the 0.52 contiguity ratio referenced in paragraph 0010 of the Present Application. This contiguity ratio was calculated for Figure 2 of the Application, which is the same figure as Figure 3 of the Jacobs patent. My calculation of the contiguity ratio of the material shown in Figure 2 of the Present Application is set out below. (I note that in calculating the contiguity ratio again, in this Declaration, the result was 0.53.)

10. I understand that the Examiner also has inquired whether the embodiment shown in Figure 4 of the Jacobs patent has a contiguity ratio within the contiguity ratio range recited in claim 1 of the Present Application. I note, however, that a contiguity ratio cannot be calculated for Figure 4 of the Jacobs patent. Figure 3 of the Jacobs patent is a photograph at 100X magnification. It shows a darker-colored discontinuous phase of cemented carbide within a lighter-colored continuous phase of cemented carbide. These are the two relevant phases for calculating the contiguity ratio of a hybrid cemented carbide, and both must be shown in a photograph in order to calculate the contiguity ratio from the photograph. Figure 4 of the Jacobs patent is a photograph of the same material shown in the Jacobs patent's Figure 3, but is at 1500X magnification, which is 15 times the magnification of Figure 3. Because of the extreme magnification shown in Figure 4 of the Jacobs patent, only the darker-colored, discontinuous phase is shown in Figure 4. Because Figure 4 does not also show the lighter-colored, continuous binder phase, one cannot calculate a contiguity ratio from Figure 4 of the Jacobs patent. Nevertheless, because Figure 4 of the Jacobs patent depicts the same material as shown in the patent's Figure 3, the contiguity ratio of the material was calculated (from Figure 3) to be 0.53 below.

11. I also present below in this Declaration a calculation of the contiguity ratio of an embodiment depicted in Figure 4B of the Present Application. The Present Application refers to Figure 4B as showing a material having a contiguity ratio of 0.31. (When I re-calculated the contiguity ratio for Figure 4B in this Declaration below, the result was 0.32.)

12. Following is a calculation of the contiguity ratio of Figure 2 of the Present Application, which is the same as Figure 3 in the Jacobs patent, and which is the same material as shown in Figure 4 of the Jacobs Patent:

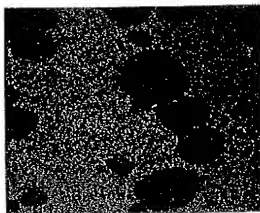
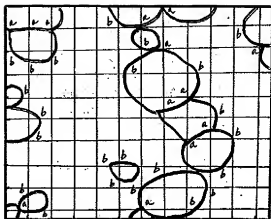


FIGURE 2

Above – Figure 2 of the Present Application  
(same as Figure 3 in the Jacobs Patent, and same  
material as shown in Figure 4 of the Jacobs Patent)



Above – Schematic of photomicrograph shown above.

Procedure for Contiguity Measurement:

A schematic version of the photograph is traced out, showing the periphery of the discrete dispersed hard phase particles in the material. Each of the traced lines is an interface between dispersed hard regions or an interface between a dispersed hard region and the softer, continuous binder region. A square grid is laid down on the schematic as shown, and the number of points of intersection of the grid lines with hard region-hard region interfaces (labeled as "a" above) and with hard region-softer region interfaces (labeled as "b" above) are counted. In the diagram shown above:

a = 13 points, and b = 23 points.

The contiguity ratio is calculated by the following equation:

$$\text{Contiguity Ratio} = 2(a) / [2(a) + b] = 26 / (26 + 23) = 26 / 49 = \underline{0.53}$$

13. Following is the calculation of the contiguity ratio of Figure 4B of the Present Application:

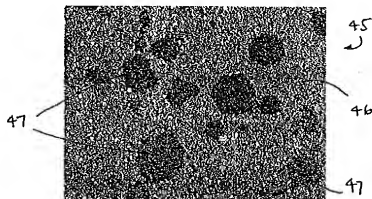
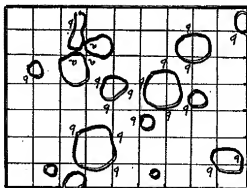


FIGURE 4B

Above – Figure 4B of the Present Application



Above – Schematic of Figure 4B


Points of intersection of grid and hard region-hard region interface lines (a) = 4

Points of intersection of grid and hard region-softer region interface lines (b) = 17

$$\text{Contiguity Ratio} = 2(a) / [2(a) + b] = 8 / (8 + 17) = 8 / 25 = \underline{0.32}$$

14. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any registration resulting therefrom.

Date: 8/27/07

  
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Prakash K. Mirchandani